

REMARKS

By this Amendment, claims 1-9 are cancelled, and claims 10-22 are added. Thus, claims 10-22 are active in the application. Reexamination and reconsideration of the application are respectfully requested.

The specification and abstract have been carefully reviewed and revised to correct grammatical and idiomatic errors in order to aid the Examiner in further consideration of the application. The amendments to the specification and abstract are incorporated in the attached substitute specification and abstract. No new matter has been added.

Also attached hereto is a marked-up version of the substitute specification and abstract illustrating the changes made to the original specification and abstract.

On page 2 of the Office Action, claims 3 and 4 are rejected under 35 U.S.C. § 102(b) as being anticipated by Yoshizawa et al. (U.S. 6,132,900). This rejection is believed to be moot in view of the cancellation of claims 1-9. Furthermore, the Applicants respectfully submit that this rejection is inapplicable to new claims 10-22 for the following reasons.

An object of the present invention is to provide an improved type of a secondary battery which can reduce the manufacturing and parts costs of producing such a secondary battery. In order to achieve this object, the present invention provides several embodiments for reducing the number of parts required to assemble such secondary batteries, and thereby reduce the manufacturing and parts cost of producing secondary batteries such as lithium ion batteries.

In order to achieve the above-described object, the present invention provides for a lid of a secondary battery having a reduced number of parts in comparison to the conventional lid of a secondary battery. In order to reduce the number of the lid in comparison to the conventional lid,

the lid comprises a terminal member and an insulating member, where the terminal member and the insulating member are superposed on a peripheral edge of a hole formed in the body with the insulating member being arranged under the terminal member. The lid of the present invention further comprises a sealing member which is inserted in the hole formed in the body. The sealing member is formed from a flange portion and a separate cylindrical portion. The flange portion consists essentially of a flat portion. The cylindrical portion consists essentially of a cylindrical portion that is separate from the flange portion of the sealing member. The lid of the present invention also comprises a rivet that is inserted in the sealing member and caulked in order to join the terminal member and the insulating member to the body. The rivet of the present invention comprises a shank and a head, where the shank has a first end inserted in the sealing member and caulked to join the insulating member and the sealing member to the body, and a second end opposite from the first end, where the head is provided on the second end. The present invention also provides that a lead wire is directly connected to the caulked first end of the shank.

New claims 12 and 17, which were added in favor of cancelled claims 3 and 4, respectively, each define the lid as comprising an insulating member mounted in the hole formed in the body, and a sealing member having a flange portion at one end thereof and inserted in the hole formed in the body. New claims 12 and 17 also each recite a rivet comprising a shank and a head, where the shank is recited as having a first end inserted in the sealing member and caulked to join the insulating member and the sealing member to the body, and as having a second end opposite from the first end, where the head is provided on the second end of the shank. New claims 12 and 17 also each recite a lead wire directly connected to the first end, which is the caulked end, of the shank.

Yoshizawa et al. discloses that the negative electrode lead ribbon 12 (“lead wire”) is directly connected with the washer 6, while the positive electrode lead ribbon 11 (“lead wire”) is directly connected with the inner surface of the seal plate 2. Since the negative electrode lead ribbon 12 is indirectly connected to the rivet 5 through the washer 6, and the positive electrode lead ribbon 11 is indirectly connected to the rivet 5 through the inner surface of the seal plate 5, Yoshizawa et al. fails to disclose or suggest a lead wire directly connected to the first end of the shank of the rivet, as recited in new claims 12 and 17. Clearly, Yoshizawa et al. does not disclose or suggest a lead wire directly connected to the caulked first end of the shank of the rivet, as recited in new claims 12 and 17.

Therefore, the Applicants respectfully submit that new claims 12 and 17 are not anticipated by Yoshizawa et al.

Moreover, according to Figure 1 of Yoshizawa et al., it would not have been obvious to one of ordinary skill in the art to modify the lid of Yoshizawa et al. to result in the lead wires 11 or 12 being directly connected to the caulked end of the rivet 5, as recited in new claims 12 and 17. As disclosed in Figure 1 of Yoshizawa et al., the caulked end of the rivet 5 is not flat and is extremely small in its surface area. As described in the present invention and in Yoshizawa et al., lead wires are connected to members of the lid by welding. In order to weld two members together, their respective flat surfaces are pressed against each other and are then welded together. If either of the mating surfaces are not sufficiently flat or sufficiently large in surface area, it is virtually impossible to weld the two surfaces together. Accordingly, by providing a caulked end of the rivet 5 which is not flat and which is extremely small in surface area, the Applicants respectfully submit that

Yoshizawa et al. does not disclose or suggest a lead wire directly connected to the first end of the shank of the rivet which is caulked, as recited in new claims 12 and 17.

Accordingly, since Yoshizawa et al. fails to disclose each and every limitation of new claims 12 and 17, the Applicants respectfully submit that new claims 12 and 17 are clearly allowable over Yoshizawa et al.

On page 3 of the Office Action, claims 1-9 are rejected under 35 U.S.C. § 103(a) as being unpatentable over JP 11167900 A (hereinafter “JP ‘909”) in view of Saito et al. (U.S. 5,586,993). This rejection is believed to moot in view of the cancellation of claims 1-9. Furthermore, the Applicants respectfully submit that this rejection is inapplicable to new claims 10-22 for the following reasons.

Similar to Yoshizawa et al., JP ‘909 and Saito et al. each fail to disclose or suggest a lead wire directly connected to the caulked end of the rivet, as recited in new claims 12 and 17. JP ‘909 specifically provides that a rivet 5 is arranged in the sealing board 2 and a metal washer 7 is threaded on the rivet, and that the lead board 13 is indirectly connected to the rivet 5 through the lower insulation gasket 8. Accordingly, by disclosing that the lead board 13 is indirectly connected to the rivet 5 through the lower insulation gasket 8, JP ‘909 fails to disclose or suggest a lead wire directly connected to the first end of the shank of the rivet, as recited in new claims 12 and 17. Moreover, Saito et al. does not disclose or suggest a lead wire directly connected to the first end of the shank of the rivet which is caulked, as recited in new claims 12 and 17. Saito et al. discloses that the gasket 6 and insulating spacer 9 provide for electrical insulation between the cover plate 2 serving as a negative element and the hollow rivet 3 serving as a positive element and between the cover plate 2 and the lead piece 7 serving as a positive element (see Column 5, lines 50-54). Further, Saito et

al. discloses that the lead piece 7 provides an electrical connection between the positive terminal 4 and positive plates 1c in an electrical power generator element 1a, via positive collectors 1b connected to the lead piece 7 and hollow rivet on which the lead piece is fitted (see Column 6, lines 26-30). Accordingly, Saito et al. discloses an indirect electrical connection between the positive terminal 4 and the outside surface of the hollow shaft 3b of the rivet 3 through the lead piece 7. Saito et al., therefore, fails to disclose or suggest a lead wire directly connected to the caulked first end of the shank of the rivet, as recited in new claims 12 and 17.

Therefore, neither JP '909 nor Saito et al., or the collective teachings thereof, disclose or suggest a lead wire directly connected to the first end of the shank of the rivet which is caulked, as recited in new claims 12 and 17. Accordingly, since JP '909 and Saito et al. fail to disclose or suggest each and every limitation of new claims 12 and 17, the Applicants respectfully submit that new claims 12 and 17 are clearly allowable over JP '909 in view of Saito et al.

New claims 10 and 21 each recite a lid of a secondary body comprising a plate-shaped body having a hole formed therein, a terminal member, and an insulating member, where the terminal member and the insulating member are superposed on a peripheral edge of the hole formed in the body with the insulating member being arranged under the terminal member. New claim 10 recites a sealing member having a flange portion at one end thereof and inserted in the hole formed in the body, where the sealing member consists essentially of a flat plate portion having a hole to form the flange portion, and the sealing member consists essentially of a cylindrical portion that is separate from the flange portion. New claim 21 recites a sealing member having a flange portion at one end thereof and inserted in the hole formed in the body, where the sealing member comprises a substantially flat plate portion having a hole to form the flange portion, and a substantially cylindrical

portion that is separate from the substantially flat plate portion of the sealing member. New claims 10 and 21 also each recite a rivet inserted in the sealing member and caulked in order to join the terminal member and the insulating member to the body.

In rejecting claims 1-9 on pages 3-4 of the Office Action, the Examiner asserted that JP '909 discloses all of the limitations of claims 1-9, except that JP '909 does not disclose or suggest a rivet inserted in the sealing member and caulked in order to join the terminal member and the insulating member to the body. To teach this feature, the Examiner applied Saito et al., and asserted that Saito et al. teaches that the hole of the lid is caulked in order to seal and fix the rivet to the cover plate. The Examiner thus concluded that it would have been obvious to one of ordinary skill in the art at the time the invention was made to "caulk the terminal member and insulating member to the plate shaped body as caulking the members will allow for a strong, durable seal between the components of the lid in order to prevent interaction between elements of the interior and exterior environments of the battery casing".

However, despite the Examiner's assertion to the contrary, JP '909 does not disclose or suggest the sealing member as recited in original claim 1 or in new claims 10 and 21. New claims 10 and 21 have been rewritten, relative to original claim 1, to further clarify that the sealing member of the present invention has one flat plate portion and one cylindrical portion that are each separate from each other, which is not disclosed or suggested by JP '909 or Saito et al.

JP '909 discloses separate upper and lower insulation gaskets ("sealing members") 6 and 8, respectively. The upper insulation gasket 6 includes a cylindrical portion, while the lower insulation gasket 8 includes a flat portion. However, the upper insulation gasket 6 also includes a flange portion integral with and radially extending from the cylindrical portion of the upper insulation

gasket 6. Further, the lower insulation gasket 8 also includes a cylindrical portion integral with and axially extending from the flat plate portion of the lower insulation gasket (see Figures 1-4).

The present invention, on the other hand, as recited in new claim 10, provides a sealing member having a flange portion at one end thereof and inserted in the hole formed in the body, where the sealing member consists essentially of a flat plate portion having a hole to form the flange portion, and the sealing member consists essentially of a cylindrical portion that is separate from the flange portion. Further, the sealing member of new claim 21 is recited as having a flange portion at one end thereof and inserted in the hole formed in the body, where the sealing member comprises a substantially flat plate portion having a hole to form the flange portion, and a substantially cylindrical portion that is separate from the substantially flat plate portion of the sealing member. Accordingly, by disclosing a “sealing member” 6, 8 having both a flat plate portion and a cylindrical portion that are not separate from each other, JP ‘909 does not disclose or suggest a sealing member having a flange portion at one end thereof and inserted in the hole formed in the body, where the sealing member consists essentially of a flat plate portion having a hole to form the flange portion, and the sealing member consists essentially of a cylindrical portion that is separate from the flange portion, as recited in new claim 10. Further, by disclosing a sealing member 6, 8 having both a flat plate portion and a cylindrical portion that are not separate from each other, JP ‘909 does not disclose or suggest a sealing member having a flange portion at one end thereof and inserted in the hole formed in the body, where the sealing member comprises a substantially flat plate portion having a hole to form the flange portion, and a substantially cylindrical portion that is separate from the substantially flat plate portion of the sealing member, as recited in new claim 21.

Moreover, Saito et al. also does not disclose or suggest a sealing member having a flange portion at one end thereof and inserted in the hole formed in the body, where the sealing member consists essentially of a flat plate portion having a hole to form the flange portion, and the sealing member consists essentially of a cylindrical portion that is separate from the flange portion, as recited in new claim 10, or a sealing member having a flange portion at one end thereof and inserted in the hole formed in the body, where the sealing member comprises a substantially flat plate portion having a hole to form the flange portion, and a substantially cylindrical portion that is separate from the substantially flat plate portion of the sealing member, as recited in new claim 21. Instead, Saito et al. discloses a gasket 6 comprising a cylindrical portion 6a having an outer diameter that is slightly smaller than the center hole 2a of the cover plate and an inner diameter that is slightly greater than the outer diameter of the hollow shaft 3b of the hollow rivet 3, and a flange 6b formed integrally with the cylindrical portion 6a and having an oval shape which is substantially the same as the oval recess 2b formed on the cover plate 2 (see Column 5, lines 58-64). Accordingly, both JP '909 and Saito et al. fail to disclose or suggest the sealing member as recited in new claims 10 and 21. Therefore, since the applied references do not disclose each and every limitation as recited in new claims 10 and 21, the Applicants respectfully submit that new claims 10 and 21 are clearly allowable over JP '909 in view of Saito et al.

Because of the clear distinctions discussed above, it is submitted that the teachings of the applied references, taken individually or in combination, do not meet each and every limitation of new claims 10, 12, 17 and 21. Furthermore, it is submitted that the distinctions are such that a person having ordinary skill in the art at the time the invention was made would not have been motivated to modify Yoshizawa et al., JP 11167909 A or Saito et al. in such as manner as to result

in, or otherwise render obvious, the present invention as recited in new claims 10, 12, 17 and 21. Therefore, it is submitted that new claims 10, 12, 17 and 21, as well as new claims 11, 13-16, 18-20 and 22 which depend therefrom, are clearly allowable over the prior art of record.

In view of the foregoing amendments and remarks, it is respectfully submitted that the present application is clearly in condition for allowance. An early notice thereof is respectfully solicited.

If, after reviewing this Amendment, the Examiner feels there are any issues which must be resolved before the application can be passed to issue, the Examiner is respectfully requested to contact the undersigned by telephone in order to resolve such issues.

Respectfully submitted,

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Cover for Secondary Battery

BACKGROUND OF THE INVENTION

[0001] ~~This~~ The present invention relates to a secondary battery, and more particularly to an improved type thereof which can be manufactured inexpensively.

[0002] ~~Spreading~~ The increased prevalence of cellular phones is an eye-opener. As power sources of such cellular phones, lithium ion batteries are typically used in place of nickel-cadmium batteries and nickel-hydrogen batteries.

[0003] Since lithium ion batteries are higher in ~~the~~ working voltage and ~~large~~ larger in ~~the~~ energy capacity as compared to nickel-cadmium batteries, they are durable and have such electrical properties that they are less likely to deteriorate due to additive charging. Further, lithium ion batteries ~~they~~ are lightweight. Due to these ~~facts~~ properties, ~~they~~ lithium ion batteries are advantageous for use in light, thin, short and small devices such as cellular phones and video cameras.

[0004] But, while lithium ion batteries have the above-described advantages, a problem is that they are expensive.

[0005] An object of ~~this~~ the present invention is to provide a lithium ion battery which is less expensive than the conventional lithium ion battery.

SUMMARY OF THE INVENTION

[0006] In order to solve the above object, ~~in this invention,~~ the structure of a lid of a lithium ion battery has been improved in the present invention so that it can be manufactured at a low

cost to thereby reduce the cost of the entire lithium ion battery. First, referring to Figs. 2 and 3, the structure of the lid of a conventional square-shaped lithium ion battery will be described.

[0007] The lid 10 of the square-shaped lithium ion battery shown in Fig. 2 has a body 1 formed of an iron plate plated with aluminum or nickel, and has a rectangular shape corresponding to the shape of a housing on which it is placed. To the center of the body 1, a rectangular terminal member 2 for mounting a lead wire is joined by a rivet 5 through a sealing member 4 together with an insulating member 3 slightly bigger than the terminal member 2. In the figures, thin-wall portions 6 of the body 1 function as a safety valve if the internal pressure of the housing rises. A hole 7 is provided to pour an electrolyte.

[0008] Next, a combined form of these parts of the lid 10 is described with reference to Fig. 3, which is an exploded perspective view.

[0009] As shown in Fig. 3, ~~at the center of the body 1,~~ a hole 1a for mounting the terminal member 2 and the insulating member 3 is formed at the center of the body. Through-holes 2a and 3a are also formed in the center of the terminal member 2 and the insulating member 3, respectively, to mount ~~them~~ the terminal member 2 and the insulating member 3 to the body 1.

[0010] The sealing member 4 ~~for mounting~~ mounts the terminal member 2 and the insulating member 3 to the body 1 and is a cylinder having an outward flange 4a at one end thereof. A cylindrical portion 4b has such an outer diameter as to be fitted in the mounting hole 1a at the center of the body 1. The sealing member 4 is formed by injection-molding a polypropylene resin. Such members are mounted to the body 1 in the manner described below.

[0011] First, as shown in Fig. 3, the terminal member 2 and the insulating member 3 are superposed with the insulating member 3 under the terminal member 2 so that the centers of their respective through-holes 2a and 3a will align. Then, the terminal member 2 and the insulating member 3 ~~they~~ are placed on the body 1 with the centers of the respective through-holes 2a, 3a of these members 2, 3 aligned with the center of the mounting hole 1a at the center of the body 1.

[0012] Next, the cylindrical portion 4b of the sealing member 4 is inserted into the through-holes 1a, 2a and 3a of the three members from the back of the body 1. The rivet 5 is then inserted into the cylindrical portion 4b of the sealing member 4 from the back of the body 1 and joined by caulking. Now the cover 10 is in the state shown in Fig. 2.

[0013] A lead wire (not shown) is mounted by welding the lead wire to the surface of the terminal member 2, which has thus been mounted to the body 1. In order to ensure welding, ~~as the terminal member 2, one having~~ requires an area having a large occupying rate relative to the body 1 as shown in the figure ~~was needed.~~

[0014] ~~But due~~ Due to advancements of ~~the~~ welding technology, however, it became possible to reduce the required area to be welded to a value substantially equal to the area of the end face of the rivet 5 after caulking.

[0015] Thus, by using the rivet 5 as the terminal and welding lead wire to the rivet, the terminal member 2 can be omitted. This makes it possible to manufacture the lid 10 at a low cost due to ~~the~~ a reduction in the number of parts.

[0016] Thus, in ~~this~~ the present invention, the rivet 5 is also used as the terminal member 2 to reduce the number of parts to four.

[0017] Further, by making the sealing member 4 of an insulating material and using it also as the insulating member 3, it is possible to further reduce the number of parts to three (see Figs. 1B and 1C).

[0018] Moreover, according to ~~this~~ the present invention, the sealing member 4 may consist of a cylindrical portion 4b and flange portion 4a (Figs. 1A and 1B). Advantages of this arrangement will be described below.

[0019] Heretofore, the insulating member 3 was, as described above, formed by injection molding of inexpensive polypropylene resin. But if the housing is made thin to reduce the size (thickness) of the battery, the influence of heat produced in welding the housing and the lid 10 together increases, so that the polypropylene resin, which is inferior in heat resistance, cannot withstand the heat. Thus, it was impossible to reduce the size. Instead of polypropylene resin, using a fluororesin, which is superior in heat resistance, is considered.

[0020] But a fluororesin is not only expensive but is also difficult to injection mold, so that in order to perform injection molding, a special grade one has to be used. Thus, the cost is high as compared with other materials.

[0021] In ~~this~~ the present invention, the sealing member 4 comprises the cylindrical portion 4b and the flange portion 4a, as shown in Figs. 1A and 1B, which are separate from each other and simple in shape.

[0022] With this arrangement, disks for such simply shaped cylindrical portion 4b and flange portion 4a can be manufactured by punching or extruding a sheet material. Such work is inexpensive in cost. Thus, a fluororesin may be used, which is expensive but superior in heat resistance, it is possible

to obtain a product more inexpensive than conventional in the end.

[0023] Also, in the entire sealing member 4, the flange portion 4a is a portion for which high sealability is not as required as it is for the cylindrical portion 4b but insulating properties are mainly required for the flange portion 4a. Thus, even if ~~it~~ the flange portion 4a is deformed under the influence of heat buildup during welding, this will pose no ~~big~~ significant problem. Thus, ~~this~~ the flange portion 4a may be formed, not from an expensive fluoro-resin, but from a sheet member of inexpensive polypropylene resin by inexpensive punching. This further reduces the manufacturing cost of the lithium ion battery.

[0024] The above description has been made with reference to a lithium ion battery. But this invention is not limited to lithium ion batteries but is applicable to other secondary batteries such as nickel-cadmium batteries and nickel-hydrogen batteries if the lid has the same structure for the connection of the lead wires.

[0025] Other features and objects of the present invention will become apparent from the following description made with reference to the accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] Figs. 1A, 1B and 1C are sectional views of lids of first, second and third embodiments of the present invention;

[0027] Fig. 2A is a plan view of a conventional lid;

[0028] Fig. 2B is a sectional view of the ~~same~~ conventional lid; and

[0029] Fig. 3 is an exploded perspective view of the

conventional lid.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0030] Hereinbelow, referring to the drawings, the embodiments of ~~this~~ the present invention will be described. For parts identical to those of the conventional lid, identical numerals are used and ~~their~~ the description thereof is omitted. In the figures, lead wires connected to the lid are not shown.

(First Embodiment)

[0031] The embodiment shown in Fig. 1A is a lid 10 having a conventional terminal member 2 and an insulating member 3. ~~But the~~ The sealing member 4, however, has ~~the~~ a cylindrical portion 4b and a flange portion 4a formed separately from each other.

[0032] For the cylindrical portion 4b for which sealability is especially required, a fluoro-resin is used which is, though expensive, superior in heat resistance and is less likely to be deformed even when exposed to heat buildup during welding. It may be formed by cutting a tube made therefrom.

[0033] On the other hand, the flange portion 4a for which insulating properties are mainly required, but for which slight deformation is permitted, is formed from an inexpensive polypropylene by punching a sheet member formed therefrom into a doughnut-shaped disk.

[0034] Because for both the cylindrical portion 4b and flange portion 4a, ready-made resin tubes and plates are used without using a complicatedly shaped molds, it is possible to manufacture them at a lower cost than a sealing member 4

having the cylindrical portion 4b and flange portion 4a integral with each other.

(Second Embodiment)

[0035] In the embodiment shown in Fig. 1B, by using the rivet 5 which serves also as the terminal member 2, and the sealing member 4 which serves also as the insulating member 3, the terminal member 2 and insulating member 3 are omitted to form the lid 10 from only three parts, i.e. the body 1, solid rivet 5 and sealing member 4.

[0036] For the sealing member 4, as with the first embodiment, the cylindrical portion 4b and flange portion 4a are formed as separate elements. The cylindrical portion 4b is formed by cutting a fluororesin tube, and the flange portion 4a is formed by punching a polypropylene sheet member.

[0037] Since this embodiment has no terminal member 2 or insulating member 3, the parts cost and manufacturing cost are less expensive.

(Third Embodiment)

[0038] In the embodiment shown in Fig. 1C, instead of splitting the sealing member 4 into the cylindrical portion 4b and flange portion 4a as in the second embodiment, an integral ~~one~~ sealing member 4 is used, which is formed by injection molding.

[0039] As described above with regard to the second embodiment and which can be seen in Fig. 1C, the rivet 5 serves as the terminal member 2, and the sealing member 4, being integrally formed, serves as the insulating member 3. Accordingly, similar to the second embodiment, the third embodiment of the present invention omits both the terminal

member 2 and the insulating member 3.

[0040] ~~By this~~ Further, by the arrangement according to the third embodiment, the number of parts is smaller than in the second embodiment, and can be reduced to only three, i.e. the lid body 1, rivet 5 and sealing member 4. Assembly is thus simplified.

[0041] But since a complicated shape having the cylindrical portion 4b and flange portion 4a integral with each other cannot be manufactured by extrusion molding, it is formed by injection molding. As described above, in this method, instead of using a fluoro-resin, which ~~pushes up~~ increases the cost, a polypropylene is used.

[0042] Thus, since a polypropylene resin is inferior in heat resistance to a fluoro-resin, in order ~~that~~ for heat can to be dispersed to the surroundings, this embodiment is applicable to one in which the lid body 1 has larger dimensions, such as its width and length, as compared with the dimensions of the second embodiment.

[0043] The structure of the lid 10 of each embodiment is, as described above, applicable to a nickel-cadmium battery, nickel-hydrogen battery or any other secondary battery. In view of the structure thereof, ~~they~~ lids of these type of batteries can also be manufactured less expensively than the cost for manufacturing conventional lids.

[0044] In this invention, since the lid of a secondary battery is structured as described above, the secondary battery can be manufactured at a lower cost than the conventional secondary battery.

ABSTRACT OF THE DISCLOSURE

By using a rivet which serves also as a terminal member, and a sealing member which serves also as an insulating member, ~~a~~ the terminal member and ~~an~~ the insulating member can be omitted, thereby forming the lid of the secondary battery from only three parts, i.e. the body, rivet and sealing member. The sealing member includes a cylindrical portion and a flange portion which are separate members. The cylindrical portion is formed by cutting a fluororesin tube. The flange portion is formed by punching a polypropylene resin sheet. Thus, the number of parts can be reduced to four, so that it is possible to reduce the parts cost and manufacturing cost as compared to conventional lids.